Fundaments of Animal Knowing: Establishing Relations Between Sensations, Actions and the World [1]

Donald Favareau
University Scholars Programme, National University of Singapore, favareau@biosemiotics.org

ABSTRACT: If "semiosis" is defined to be the essentially mind-dependant use of symbols characteristic of both human language and thought, then a research project calling itself "bio-semiotics" would certainly not be able to tell us anything scientifically verifiable whatsoever about animals, cells, brains, or biological systems *per se*. This, then, is one of the first of many initial misconceptions that one has to clear away when beginning to speak about biosemiotics to an audience unfamiliar with its premises: for to biosemioticians, *semiosis*, in its first instance and definitional essence, is not about *thought*, but about *relations* – and, in particular, about those relations that eventually make thought possible: i.e., the subject-object-actions relations that must obtain between an organism and its sensations of, and actions upon, the world in which it is embedded and in which it must survive. Having been asked to present an "very introductory" talk on some of the basic premises of biosemiotics here today, I would like to present a beginner's overview on some of the work done by in biosemiotics – particularly by Deacon (1997) and Hoffmeyer (1996) – regarding the Peircean hierarchy of *iconic, indexical and symbolic* relations underlying the abilities of animals to detect, categorize, and act appropriately upon the world and, in at least one possibly unique case (which is our own), to reason about such phenomena itself through the publicly shared semiotic prosthesis that is language.

Introduction

On November 12-14, 2004 an eight-member panel of biologists, linguists, anthropologists and neuroscientists was convened at the University of California, Los Angeles to discuss the appropriate data on which to base an evolutionary and neurobiological account of language. Convened under the directorship of Professor John Schumann of the UCLA Department of Applied Linguistics, the theme of the three-day panel discussion was "Language Evolution: What Evolved?" As a participant in this roundtable, one of the questions that I asked the panel was asked to consider was:

> Should the search to discover the origins of human language start by searching for the earliest instances of what we can already recognize as human language activity (e.g., written words or symbols) – or is this already a "too late" starting point for understanding language as part of an evolutionary continuum?

I was invited to participate in this panel so as to offer a "biosemiotic" perspective to this question. And at that time, as today, I found myself amongst scholars for whom the idea of "biosemiotics" was still *terra incognita*. So as a way of introducing some of the fundamentals of biosemiotics into this transdisciplinary context, I thought that I would take this opportunity to present, in just a kind of elementary way, some basic principles of biosemiotics as they might apply to this question about

---

[1] Citation: Favareau, D. (2007). Fundaments of Animal Knowing: Establishing Relations Between Sensations, Actions and the World. In *Biosemiotics in Transdisciplinary Contexts*. Guenther Witzany (Ed.) Helsinki: Umweb Press. pp. 61- 69.

language origins. My hope, of course, is that many of the non-linguists here today will also see the potential for applying this perspective to similar questions in their own fields of inquiry, as well.

So, then, to proceed: What I would like to do here today is to expound a bit upon the notion that human language was not the birth of publicly shared semiotic systems – but rather, that it is itself the product of more primitive semiotic relations that have evolved throughout the natural world. To do this, I would like to briefly sketch out here a general picture that suggests a continuity between human language-based thought processes and their pre-linguistic evolutionary precedents in the experiential and enacted "knowing" of the world by animals, fish, insects, and plants. I will then end on a few words about some of the epistemological novelty introduced by the human system, and reiterate the need for an explanatory account that can account for both the continuities and the discontinuities between animal knowing and human knowing within a single, principled schema.

I want to argue, in short, that at a time when strictly materialist-reductionist explanations of life and its evolution have become increasingly incompatible with what biologists are now conceding is the complex, adaptive, and non-linear nature of organismic organization and interaction in the natural world – the conceptual work now taking place under the aegis of the *biosemiotics*[-12] may help us better understand the principles whereby not only our human social world and its linguistic systems, but also the very biological world and its multitude of (species-specific) semiotic systems came into being not as a "given" in the furniture of the universe, but as a locally organized, massively co-constructed, context-creating and context-sustaining interactional *achievement* in this small pocket of the universe instead.

Being the study of sign processes as they appear variously across the biological spectrum, the interdisciplinary project of biosemiotics is grounded in the conviction that the living organism must be understood not only in its material organization – but also in the organization of its interactions, both internal and external. Biosemiotics holds that these two sets of organizing relations are interdependently co-causal, and that organisms' successful establishment of *sign relations* mediate such activity as gives rise to adaptive and intelligent behavior in the world.

How best to think non-anthropomorphically about such sign relations is still a point of ongoing debate and investigation within the community of biosemioticians, so I should clarify here at the outset that the school of biosemiotics that I will be drawing upon is the Copenhagen-Tartu school. As characterized by the work of Emmeche, Hoffmeyer and Kull, [4-8] this perspective is informed primarily by philosopher Charles Sanders Peirce's (1839-1914) semiotic logic of relations, animal ethologist Jakob von Uexküll's (1864-1944) constructivist biology of perception, and physicist and chemist Ilya Prigogine's (1917-2003) explication of self-organizing systems as decentralized accomplishments.

It is also highly influenced by, and overlaps to some extent, with the work of American bioanthropologist Terrence Deacon[13] in its attempt to articulate a scientific understanding of the disparate ways that *sign processes* permeate the relations of living systems. This is no small undertaking, as – to stay just on the most obvious levels – one sees that "sign processes" are ineliminably implicated in the phenomena of human spoken language and written texts; in a variety of primate, canine and reptilian display behavior; in birdsong; in pheromone trails; as well as in the deceptive scents, textures,

movements and coloration of a wide variety of symbiotically interacting insects, animals and plants. Less obviously, perhaps, there are the chemotaxic sign-relations by which single celled animals negotiate the world of alien "externality;" the intercellular sign exchanges upon which the human body's internal networks operate and self-regulate; the chemical and electrical events that constitute the "signals and messages" of the brain and central nervous system; and the nucleotide sequences that, when read by cellular mechanisms, give rise to life from the genetic code.

All of these phenomena are examples of true sign processes – i.e., substitution relations whereby something is "re-presented" to an organism by something other than itself – and yet each of these instantiations differ from each other in a number of fundamentally important ways. In this talk, I want to briefly make the case that the non-linguistic, non-brain-based setting up of successful "sign" relations is both ubiquitous throughout the biological world, and the basis upon which our later linguistic sign relations are made possible.

The term "sign" denotes a relation, not a thing

Until very recently, no one discipline has attempted to provide a synthetic explanation of precisely how the *cultural* processes of sign use and the *biological* processes of sign use do and do not relate. In its efforts to ameliorate this situation, Copenhagen-Tartu biosemiotics employs the semiotic logic of relations developed by philosopher and scientist Charles S. Peirce in order to distinguish the various orders of sign processes ubiquitous to the world of living beings. As even a thumbnail description of Peirce's multi-leveled architectonic is well beyond the temporal limitations of this talk, it will suffice for now to explicate just two of the Peircean categories relevant to the discussion of language evolution. These are: (1) the fundamental triadic relationship of *representamen-object-interpretant* which alone makes sign use possible, and (2) the nested hierarchy of sign types *icon-index-symbol* which, as Terrence Deacon[13] has very thoroughly and convincingly argued, both underlies the ability of human language use as well as establishes its continuity (and singular point of discontinuity) with the sign processes of the rest of the animal kingdom. Taking these two ideas in order, then:

A *sign*, for Peirce,[14] is "something which stands to somebody for something … not in all respects, but [only] in reference to…[its] ground" (2.228).[2] Reading this definition carefully reveals that: (1) There are no such independently existing entities as "signs" *per se* – instead, there are only independently existing entities that are used *as* signs by the agents that act upon them as such. (2) Such triadic action (the taking of entity or state *x* to "stand for" *y* by agent *z*) alone brings the "sign relation" into being. (3) By necessity, then, such action requires a living agent to actively bring into relation the sign vehicle, or *representamen* (that *x* in the world which will function to the organism as a sign for *y*) with its *object* – an object which is not "*y* in itself" but only those aspects of *y* relevant to the experiential world of the agent (cf. Peirce 2.229, 5.401). (4) This using of one discrete part of the world (*x*) as the means by which to orient oneself epistemologically towards some other more general part of the world (*y*) allows for the creation of an effective *interpretant* – or "proper significate

[2] Following convention, my citations here employ the notation system developed for the *Collected Papers of Charles S. Peirce*, which is the standard reference work in Peirce scholarship.

effect" (5.475) through which an agent comes to feel, act upon and ultimately reason about that set of relations joining both its own internal biology with the physical organization of the world external to it.

To give an immediately accessible example, the listener (or reader) is doing just what Peirce describes right now, with the *representema* that I am producing. But the same rules of logic have also been at work at the level of the lineage, as is evidenced by the panoply of ways that animals have evolved to sense the world. And, in fact, if there is a "theme" to evolution at all, it may be that of *the development of increasingly complex biologies for*: (1) "perceiving" the world through the registering of *signs of presence;* (2) "interacting with" the world through acting upon *signs of association*; and (3) "reasoning about" the world through the virtual manipulation of *signs of signs*.

Peirce characterized these experiential phenomena as the nested relations of *firstness, secondness* and *thirdness*, respectively – with the characteristic sign types corresponding to each of these hierarchical categories being *icons, indexes,* and *symbols*. Thus, to the extent that a sign "partakes in the *character* of its object," it is an *icon*; to the extent that a sign is "really and in its individual existence *connected* with its individual object," it is an *index*; and to the extent that a sign "will be interpreted as denoting the object, in consequence of a *habit*," convention or law, it is a *symbol* – but again, all of this is only *for* the agent to whom the object *is being used as* a sign of something other than itself at all (4.531).

Now, this all may seem quite abstract – and perhaps even incomprehensible – as presented in this condensed fashion so far. But at the heart of this schema lies the absolutely mundane (and therefore radically under-examined) phenomenon of animals reliably going about their survival business in the world, without the need for any kind of explanatory anthropomorphism.

The key to this understanding is that "sign relations" are primarily *not* something psychological, linguistic or even human-specific – but rather, simply those internal-to-external relations that all living organisms must establish in order to successfully negotiate the never "fully knowable" world upon which all aspects of their lives depend. In this way, biosemiotics makes relevant for our understanding of language evolution animal ethologist Jakob von Uexküll's (1864-1944) constructivist notions of species-specific perception-action cycles *(Funktionkreis)*, along with those subjective experiential worlds (*Umwelten*) that such perception-action cycles give rise to in animals over evolutionary time. Looking at some everyday examples of these perception-action cycles and their real-world consequences may make such seemingly "abstract" articulations more clear:

Von Uexküll[15] noted that the world that is inhabited jointly by all species is perceived in radically differently fashions by each of them – as a world of sonar, for example, or of pure olfaction, or of ultraviolet radiation or, as with us, as a world of complex visual and aural experience, yet one wherein the ultrasonic and UV reality that may be perceptible to one's neighboring creatures fails to show up as experiential "reality" at all. More centrally: It is only from among the "objects" of this *experiential* world that the organism has the ability to choose its inescapably consequential actions in the surrounding material world. Von Uexküll's most famous example of such a highly limited but perfectly species-preserving *funktionkreis*-and-*umwelt* dynamic is that of the tick.

Semiosis in action

The tick, noted von Uexküll,[15] lives in a perceptual world consisting only of the presence and absence of butyric acid, some elementary tactile sensation and a crude sensitivity to heat. Yet from this apparently impoverished sensorium emerges a tightly conjoint action-response schema grounded in the subjective experience of these three phenomena alone. Thus, the tick hangs deaf, blind and motionless on its branch until the presence of butyric acid (a component of animal sweat) appears in not just in the world *per se*, but also in the world of its subjective experience – at which point alone, the tick stirs to action and releases its grip. Falling on to the source of the butyric acid – i.e., the body of the warm-blooded animal that was passing below the deaf and sightless tick – the tick's registration of tactile contact initiates its motor schema of running in the search for body-temperature heat (such heat in this case being a reliable sign of skin, as opposed to animal fur, hoof, tooth or other non-penetrable material). Finally, upon registering the presence of the appropriately temperatured heat, the tick begins burrowing into the animal's skin to feed.[15:10-12]

Given that the tick has no visual or aural apparatus, and gives no evidence of having even the ability of detecting anything other than the three specific aspects of the world above, it would make no sense to say that the tick "knows" that the blood it feasts on is carried by such unfathomable phenomena as "horses", "cows" and "pigs", much less that it " knows" that it is the sweat of these animals that carries the butyric acid that alone sets the tick's function cycle in action, feeding it and allowing it to survive. And yet: there *are* such things as horses, cows and pigs actually existing in the world and it *is* the sweat of these animals that carries the butyric acid that *alone* sets the tick's "function cycle" in action, feeding it and allowing it to survive.

What this reveals to us about *sign-processes* thus is crucial: Sign processes are not, foundationally and in their *firstness,* linguaform codes corresponding to psychological conceptual categories – but are rather, just as we have described them above, "substitution relations whereby something is "represented" to an organism by something other than itself".[16,17]

In Peircean terms, the tick's *Umwelt* or experiential world "carves" out of the plenum of surrounding possible perceptual experience just the three perceptual phenomena made available to it by its evolutionary heritage (i.e., the heritage of its species' perception-action cycle success over time). Brute, immediate perception or registration of these phenomena in whatever way they are experienced (i.e., not *as* "butyric acid" but simply as *that* feeling or body state as opposed to *not* that body state or as opposed to some *other* body state) constitute the *icons* of this massively successful sign relation for the tick. Those body states or feelings that are the immediate registration of butyric acid, tactile pressure or temperature gradient (however those registrations may be "experienced" by the tick) have become reliably connected with states of being in the outside world that they (the internal states) *themselves are not*, but have come to reliably *represent*. This is the essence of a "sign relation" always.

For it is not critical (nor necessary at all) for the survival of the tick to have internal "labels" for these percepts. Much less need the tick have the psychological understanding that these percepts operate as indexical signs of the objects that they signify and represent (i.e., butyric acid signifies co-present animals; a certain temperature of heat signifies the blood meal underneath those animals'

flesh, etc.). What *is* critical is that the tick *act upon* the butyric acid, tactile sensations, and temperature changes *as* the *signs* for animal presence, covering flesh and underlying blood meal, respectively. And it is the evolution of such species-specific perception-action cycles that guarantees the veridical conjoining of these agentive actions, objects and sensations.

A photon as a sign: The evolution of vision

More germane to our present discussion regarding language evolution: biosemiotics argues that what is true of the tick is true of all other living organisms – all of whom have to somehow come to "know" the world and to act in it successfully using *only* those signs made available to them by way of the perceptual apparatuses with which they has become evolutionarily endowed.[18]

Primitive sea creatures, as neuroscientist Rodolfo Llinas[19] has pointed out, could survive using only the most grossly discriminating photoreceptive patches to distinguish extremes of dark and light. Yet armed with these just these two iconic distinctions (light and dark), these animals could successfully exploit the corollary *indexical* relations that were "really and in their individual existence *connected*" with these icons. Thus, the increased availability of food – as well as the increased exposure to visually equipped predators – are part of the real-world conditions of the upper ocean, and these relations became, through natural selection, "bodily represented" in the animal through the indexical joining of its motor schema to the photoreception of iconic degrees of light. And in a complementary fashion, both shelter and relative safety from predators – but also radically diminished feeding opportunities – real-world conditions of the ocean bottom – are indexically represented within the motor schema that initiates at the registration of iconic dark. These schema "work" because of this fit between what is in the world, what is perceived by an organism, and what is action is taken upon the former as the result of the latter. In Peircean terms, it is this enacted joining of object, representamen and interpretant (respectively) that creates and defines the sign relation. And here again we see that what constitute successful *sign* relations in the first instance does not have as its fundament human minds or language-mediated thinking, speaking, or writing practices – but, rather, the triadic joining of objects by the agents of the world through substitution relations grounded and vetted in successful action, or *use*.

Accordingly, as evolution endows animals of increasing biological complexity with correspondingly fine-grained perceptual apparatuses, such apparatuses, in turn, allow the animal to engage in more complex and fine-grained interactions with the world – a world not only of objects, but of other agents also. Yet before we see the kind of classic "animal communication behavior" of mating calls, dominance displays, territory marking or even pheromone trail making, we see first that survival-enabling sign use crosses not only individual – but also species *umwelten* – as seen in the multisensory morphology of animal camouflage and in the mindless, brainless (yet fine-grained) mimicry of plants. In both these latter cases, successful survival for organism A is predicated on its exploitation of the icons and the indexes integral to sign processes employed for survival by organism B.

Semiosis without brains

An elegant example of the kind of brainless exploitation of another species' sign relations is the morphology of a thermogenic Mediterranean lily called *Helicodiceros muscivorus* or, more commonly, the Dead Horse Arum.[20] Found on gull colonies where rotting bird corpses and their atten-

dant carrion blowflies are abundant, these gruesome smelling arums precisely mimic the smell, sight, texture and even temperature of a rotting corpse in order to attract the blowflies into its prison-like chambers, deposit its pollen on them, and then finally release them to carry its seed and thus reproduce.[21,22]

Examples of such fine-grained mimicry abound in nature, but what is most relevant to our present discussion is the acknowledgement that the Dead Horse Arum cannot in any psychological or conceptual way "know" what a rotting gull corpse looks like, smells like, feels like, or what its body temperature is upon recent expiration – yet the precise reproduction of all these properties constitute the critically important "signs" that the arum uses in exploiting the carrion fly.[20] And here again: the arum cannot subjectively experience, "see" or in any self-reflectively cognitive sense, "know" even of the *existence* of such things as carrion flies – much less "understand" their role in the process of disseminating pollen. Yet because (non-psychological, non-conceptual) *sign relations* are integral to the blowflies' successful negotiation of the world – the success of the plant's survival is predicated not on its (non-existent) endosemiotic "psychology"--- but on the exosemiotic action in the world that results as its evolved biology interacts with the subjective sign experience of the fly.

Summary

As this very abbreviated "stroll through the worlds" of animal semiosis has hopefully revealed, biosemiotics argues for the *ubiquity of sign processes in nature* as evidenced across a wide spectrum of semiotically interacting animals, fish, insects and plants. It maintains, as per Hoffmeyer,[5] Stjernfelt[23] and Kull,[24] that all organisms are born into an unlabeled world of things and must use some of those things in the world as signs by which to know how to live and to survive in that world. "Knowledge" is thus *built from* the successful setting up of sign-relations under this explanatory schema.

Consequentially, in their very acts of carving up the unlabeled world of time and space into iconic relations and in setting up indexical relations across entities, organisms begin effecting the material world causally based on the immaterial mediating relationship of using things as signs. Indexes can be chained to other indexes so as to result in incredibly complex long chains of purposively adaptive behavior – and internal states such as hunger and exhaustion come to manifest in the organism's phenomenology as icons which can be bought into indexical relations with other icons.

And what does all of this plant and animal study have to do with our roundtable's topic on the evolution of language?

In a nutshell: If, as I have argued above "knowledge" is *built from* the successful setting up of sign-relations by organisms, with regard to both themselves and their surround, then intra-species "communication" of such sign relations is the way that agents use signs to build knowledge *together*. This we do not have not time to discuss here, but has been the subject of many of my other papers.[16-17] There I argue that such acts of semiotic mediation take place recursively not just at the locus of the individual, however – but perhaps most generatively on the level of aggregate, interacting societies of agents. There, sign relations can themselves be embedded in even high-order systems of substitution relations – and the history of human culture, it has been argued[13,2,25,26] consists in just

this recursive representative strategy wherein "each subsequent representation in the semiotic chain represents the prior object-sign relation, *taken itself* as a higher-level semiotic object".[27:5]

Deacon's[13] discussion of "the *culture* of symbolic reference" underlying human language use makes it clear that the primary phenomenon to be accounted for in an evolutionary account of language is not so much the faculty of a human brain or the linguistic facility of a species (much less of an individual), but rather, the development of a multiply-embedded semiotic way-of-being in the world. Characterized by a Peircean notion of *thirdness*, this way of being is predicated on a network of sign relations that are being held for use in perpetuity *outside* the agent – i.e., in a public domain of interactively-constituted sign-exchange whereby meanings can be created, negotiated and co-operatively sustained.

What I have attempted to highlight here is that *participation* in this system of pre-linguistic, real-world subject-object-action triads and their consequences alone enacts and enables "meaning"– both here and in the animal world. And in this sense, it is the natural history of organisms and their actions in the world that is the proper starting point for undertaking a natural history of signs.

REFERENCES

1. Barbieri, M. (2001). The organic codes: An introduction to semantic biology. Ancona: Pequod.
2. Deacon, T. (1997). The symbolic species: The co-evolution of language and the brain. New York: W.W. Norton.
3. Deely, J. (2001). Four ages of understanding : The first postmodern survey of philosophy from ancient times to the turn of the twenty-first century. Toronto: University of Toronto Press.
4. Emmeche, C. (1999). The biosemiotics of emergent properties in a pluralist ontology. In E. Taborsky (Ed.), Semiosis, evolution, energy: Towards a reconceptualization of the sign (pp. 89-108). Aachen: Shaker Verlag.
5. Emmeche, C. (2000). Closure, function, emergence, semiosis, and life: The same idea? Reflections on the concrete and the abstract in theoretical biology. Annals of the New York Academy of Sciences, 901, 11.
6. Hoffmeyer, J. (1996). Signs of meaning in the universe. Bloomington: Indiana University Press.
7. Hoffmeyer, J. (2000). The biology of signification. Perspectives in Biology and Medicine, 43(2), 252-268.
8. Kull, K. (1998). Organism as a self-reading text: Anticipation and semiosis. International Journal of Computing Anticipatory Systems, 1, 93-104.
9. Markos, A. (2002). Readers of the book of life : Contextualizing developmental evolutionary biology. Oxford ; New York: Oxford University Press.
10. Sebeok, T. (1990). Sign science and life science. In J. Deely (Ed.), Semiotics 1990 (pp. 243-252). Lanham, MD: University Press of America.

11. Sebeok, T. (2001). Biosemiotics: Its roots, proliferation, and prospects. *Semiotica, 134*(1), 18.
12. Turovski, A. (2000). The semiotics of animal freedom. Sign Systems Studies, 28, 380-387.
13. Witzany. G. (2006). The *Logos* of the *Bios* 1. Helsinki: Umweb.
14. Peirce, C. S. (1931-1935). Collected papers of Charles Sanders Peirce (Vol. 1-6). Cambridge, MA: Harvard University Press.
    - (1958). Collected papers of Charles Sanders Peirce (Vol. 7-8). Cambridge, MA: Harvard University Press.
15. Uexküll, J. von (1934 / [1957]). A stroll through the world of animals and men (C. Schiller, Trans.). In C. Schiller (Ed.), Instinctive behavior: The development of a modern concept (pp. 5-80). New York: International Universities Press.
16. Favareau, D. (2002). – Constructing representema: On the neurosemiotics of self and vision. Semiotics, Evolution, Energy and Development Journal, 2(4), p. 3-24.
17. Favareau, D. (2006). – Collapsing the wave function of meaning: The semiotic resource of talk-in-interaction. Journal of Biosemiotics, Vol. 3. (forthcoming)
18. Sebeok, T. (1977). Neglected figures in the history of semiotic inquiry: Jakob von Uexkull. In: T. Sebeok (Ed.), The Sign and its MastersLanham, MD: University Press of America. Pp. 197-207.
19. Llinas, R. (2001). I of the vortex: From neurons to self. Cambridge: MIT Press.
20. Angioy, A., Stensmyr, M., Urru, I., Puliafito, M., Collu. I., & Hansson, B. (2003). Function of the heater: The dead horse arum revisited. Proceedings of the Royal Society of London (Suppl).
21. Kite, G. C. (2000). Inflorescence odour of the foul-smelling aroid Helicodiceros muscivorus. Kew Bulletin 55, pp. 237–240.
22. Stensmyr, M. C., Urru, I., Collu, I., Celander, M., Hansson, B. S. & Angioy, A.-M. (2002). Rotting smell of dead-horse arum florets. Nature 420, pp. 625–626.
23. Stjernfelt, F. (2002). Tractatus Hoffmeyerensis: Biosemiotics expressed in 22 basic hypotheses. Sign Systems Studies 30.1, pp. 337-345.
24. Kull, K. (2000). Active motion, communicative aggregations, and the spatial closure of Umwelt. Annals of the New York Academy of Sciences, 901, 272-279.
25. Donald, M. (1991). Origins of the modern mind : Three stages in the evolution of culture and cognition. Cambridge, Mass.: Harvard University Press.
26. Tomasello, M. (1999). The cultural origins of human cognition. Cambridge, Mass.: Harvard University Press.
27. Parmentier, R. J. (1996). Signs in society : studies in semiotic anthropology. Bloomington: Indiana University Press.